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RECOGNIZING THE IRAQI LICENSE PLATE USING STATISTICAL FEATURES

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ABSTRACT

Number recognition is one of text detection and recognition from natural scene image tasks. Detecting and reading text from natural images is computer vision task, which has been included in the various modern applications. Some of these applications are advertisement recognition signs streets, traffic signs, recognition mobile phone numbers, license plate recognition and others. Number recognition consists of three stages, which are detection, segmentation and recognition. The first one is detecting the text or characters, second stage is segmenting the text into individual characters, and thethird stage is recognizing these characters.

KEYWORDS: Iraqi License Plate Recognition, Optical Character Recognition, Character Localization & Segmentation

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Original Article

INTRODUCTION

Excellence plates in Iraq are of the most significant applications of computer technology in the intelligent systems. The number which identifies the vehicle as a single number, placed in the calamity is usually at the bottom front of the car and the rear of the bottom of the back. It consists of several numbers. Each vehicle has two in verification number plates situated in front and back of the vehicle, written in Arabic language on one level and below direct counterpart in English language, in addition to the letter in both Arabic and English languages on the left of the plate as well as the word Iraq, and province name. The proposed system was divided into three main stages:

The first step is the preprocessing, where several algorithms are used, which are resembling algorithm, conservative smoothing algorithm, convert color image to gray, unsharp filter, sobel operator algorithm and open morphology algorithm.The second step is the segmentation, and this part is related on the results of the first phase, and the application of several algorithms is done suchas connect component labeling, find locate of Lp region, Lp resembling, binrization and Lp inverting.

The final step is the recognition, this step is done using several methods and a suggested strategy for recognition character/numbers image such as feature extraction (zoning, mean, deviation) to the nine regions, and apply some equations to these feature. Note that a sensor (Arduino Microcontrollers, Hc-Sr04 Ultrasonic Distance Sensor) is used to capture the image when the vehicle was traveling and at a fixed distance of 2 meters.

NUMBER RECOGNITION

Number recognition from image and converted to text, filled under Optical Character Recognition (OCR).The simple definition of OCR is convert unreadable information for machine of an image, or scanned paper containing

characters in to another format (the machine can recognize it as character [1]. The OCR systems are entered in many applications such as number plate recognition system recognizing the historical documents [2].The license plate recognition consists of three major parts:-

- Preprocessing part
- Segmentation part
- Recognition part

PROPOSED LPR ALGORITHM

The flowchart of the suggested approach for the vehicle license plate recognition is given in Figure (1).

Image Re-Sampling

The acquired images in the suggested implementation were reached from online videos; those images were of a high resolution with various dimensions of (Width × Height), which indicates a big number of pixels to be processed with a big duration. LPR suggested approach performs in real-time. Thus, it's very importantly decreasing the image dimensions and at the same time, maintaining the quality, which is necessary for increasing the precision of the system. Bi-linear interpolation approach is utilized for reducing the image dimensions to (920x720) pixels at the same time maintaining the quality.

Noise Removing

At this stage, there is handsome delete distortions of the captured image by the system (imaging machine).There are several uses for this purpose algorithms (mean ,median and conservative) filter to select the best one. The conservative smoothing filter is quick, simple and is widely used to reduce the noise in the image, especially the edges of the image. Usually the mask is used 3 * 3 and the method of operation is done by extracting the maximum and minimum value without the value of the center, if the value of the center between the maximum and minimum value does not change, if the value of the center is greaterthan the maximum value, we replace the value of thecenter with the maximum value. If the value of the centeris less than the minimum value, we replace the value of the center with the minimum value.The above idea can be illustrated in Figure (2).The intensity value(19) represents the value of central pixel. In this case, thevalue (19) is replaced with the maximum intensity value (17).

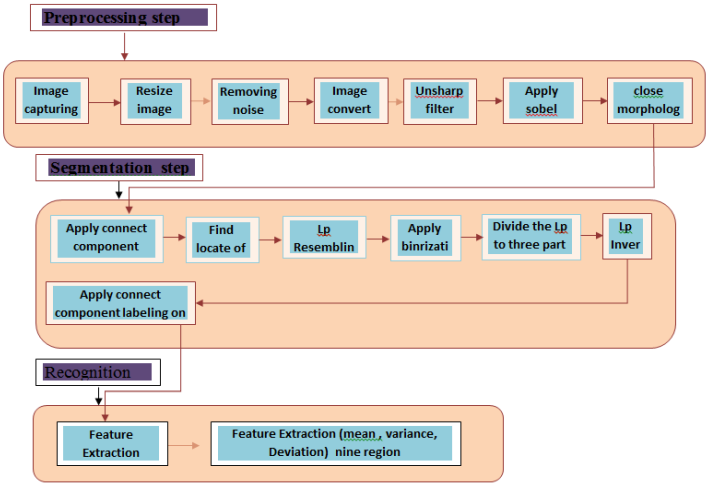

Figure 1: The Proposed Iraqi License PlateRecognition System.

13	15	16	10	10	**Neighborhood Values :** 10,10,13,14,15,15, 16,17,19 **Max Value : 17** **Min Value : 10**
12	**14**	**16**	**17**	15	
18	**10**	**19**	**15**	14	
19	**15**	**10**	**13**	13	
11	16	10	12	10	

Figure 2: Example Conservative Smoothing.

Image Convert

This process is converting inRGB image to gray image. RGB image is composed of 24 bits per 8-bit color (red, green, blue), while the gray image is made up of 8-bit value is (0 to 255).Take the value of the color red, blue, green and counted only one value.There are several ways to calculate the value of gray as in equation(1), the resulting image will be stored in array gray, shown in Figure (2)[3].

$$Gray= (0.2125R+0.715G+0.0722B \quad (1)$$

Color ImageGreyImage

Figure 3: Sample of Image Convert to Grey Image.

Unsharp Mask Filter

The unsharp mask filter is one of the types of methods that are used to edge enhancement of images. Unsharp filtering operates by subtracting a smoothed image from the original image, in order to emphasize or enhance the high-frequency information in the image (i.e. edges), as illustrated in Equation(2), the resulting from this equation is an edged image which is multiplied by a constant scaled factor K (the acceptable value of K ranging between 0.2 and 0.7), then the result is added to the original image as illustrated in Equation (3).

$$I_{edges}(r, c) = I_{original}(r, c) - I_{smoothed}(r, c) \quad (2)$$

$$I_{enhanced}(r, c) = I_{original}(r, c) - k\,(I_{edges}(r, c)) \quad (3)$$

Sobel Operator

Sometimes, this operator is called Sobel filter. Sobel operator performs two-dimensional spatial gradient measure on an image, and therefore confirms the high spatial frequency regions corresponding to the edges. Usually, it's utilized for finding the average absolute gradient magnitude at every one of the points in the gray image input. Theoretically, as a minimum, the operator is composed of a pair of beads 3 × 3 wrap. The nucleus of only one other rotated 90 degrees. Here, it is taken resulting from converting the image and apply Sobel equalization process values, and save the output in an array sobel shown in both figure (4) and (5).

Figure 4: Sample of the Iraqi Vehicle(Gray Image and Unsharp Filter).

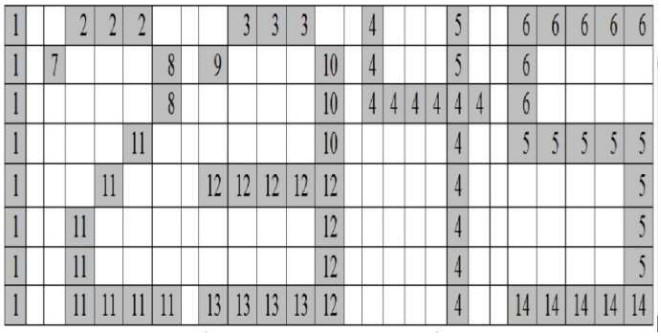

Figure 5: Sample of the Iraqi Vehicle(Sobel Edge Image).

Erosion Morphology

Identical to convolution features, assuming the domains of the image are wide enough, so that procedures do not “fall off” the edges. Erosion that has small (for example 2×2 - 5×5) square structure elements performs a shrinking on an image, via stripping away pixel layer from each of the internal and external edges of areas. The gaps and holes between various areas become bigger, and small details are removed as depicted in figure (6).

Figure 6: Erosion Morphology after Applied Four Times.

Noise Removing with Close Morphology

Noise from an extraction process consists of edges. This pixel can't be digit there, for it necessary to remove this noise pixel. The expression of close dilationis followed by erosion. After preprocessing the pixel’s array of the image, it becomes ready to enter in segmentation process. The segmentation process will identify the region in an image that represents digits by determining the dimensions of separated, and ignore all objects that frustrate to be digit. This process performs with more than one step. First, apply connected component labeling and sort the coordinate of object and convert the object into white black, then perform feature extraction.

The Approach of Connect Component Labeling Approach

This approach is utilized for performing the marks of the gaps, and building a set of those labels. Every adjacent pixel that has the same value gives it a number. And, the process is done scanning the image from top to bottom and from left to right and give the number of adjacent pixels that have the same value, and continue this pragmatic that are named all the pixels in the imageas in Figure (7).

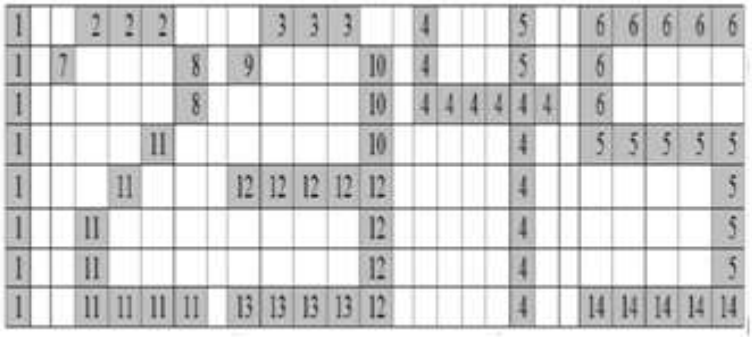

Figure 7: Connect Component Labeling.

If we look at the figure above, you will notice that some parts have more than one label, and this is a problem. To get rid of this problem, scanning the image from the bottom to the top and from right to left wasneeded (reverse the process) and be given the values of the pixels on the right to the center of pixels. So, give the pixels high to the center. After completing the entire scan image, per number of adjacent pixels are similar and have the same name (Number). And then, it is disposed of very small and very large parts. To determine the important areas (vehicle registration plate), used are some special characteristics of the vehicle registration plate. Figure (8) determine this idea.

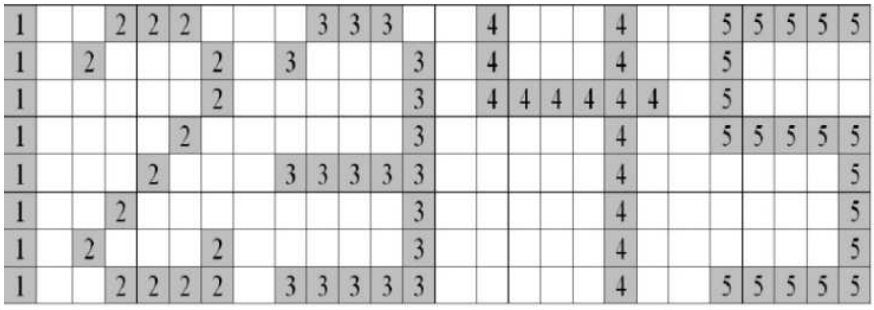

Figure 8: Determine the Imnportant Area in Connect Component Labeling.

- The “aspect ratio”: is based on (W/H), and it is between 1 and 4.
- The “dimension test”: is based on the width and height.
- The “area”: is calculated based on the number of white pixel, result between 3293 and 25583.
- The “fullness”: is calculated from (area/width*height), result between 0.6 and 0.98.

Extract the LP area from gray-scale car image via cropping this area, according to the coordinates (x,y) of the detection of the precise LP.

Re-Sampling

According to the preceding hypothesis, several of the LP samples were snapped according to the distance between the camera and the vehicle. Post testing these samples, the proper dimensions of the LP were in terms of (W = 286) and (H = 134).

Binarization

Via tests and experimentations, brightness and shadows of LP image are factors which affect the procedure of converting. Utilizing a constant threshold and OTSU global threshold resulted in a poor binarization, on the other hand, Bradley local threshold resulted in a better binarization and reduced the processing time. The Binary Bradley approach is as shown in Figure (9).

Figure 9: Describes the Binarization Bradley Approach.

Partitioning

After Operation, Binarizationt is determined by the dimensions of the vehicle registration plate, which consists of three important regions. The first region contains the ID in Arabic and English. The second important region contains the word 'Iraq' written vertically. The third region contains the name of the province and the type of vehicle. In this research, the focus is on first and third region, and lack of focus on the second region. The panel of vehicle registration areas is as shown in Figure (10).

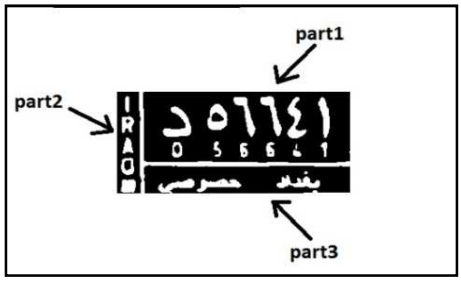

Figure 10: It Describes the Region of Lp.

After that, the dimensions are determined at the first region and split into two areas. The 1st part includes an ID. The second part contains the letter. Figure (11) shows parts of the region for the first.

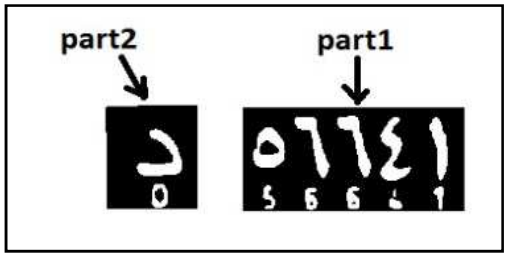

Figure 11: It Describes the Part of Region One.

After that, connecting component labeling process on the first part of the first regionis applied. Then, the resulting values are reversed and the values are sent to the recognition stage. The second part of the first region and direct values are reversed and sent to the recognition stage.

Recognition Stage

At this stage, the feature (Zoning, Mean, and Deviation) and equations are used to recognize Arabic numerals and letters.

Zoning Feature Analysis

Traditional zoning based on a 3x3 grid: Numeral recognition has been performed by a holograph-based technique. At this stage, the data is divided into nine equal parts that are dimensional, and configured to the next phase, as in Table (1).

Table 1: It Describes the Zone

Region 1	Region2	Region5
Region3	Region4	Region6
Region7	Region8	Region9

Mean, Standarddeviation

At this stage, it is taking the parts resulting from the previous stage (Zoning Feature Analysis), application of the algorithmsMean and Standard Deviation, storing the results in a matrix to be apart in the next phase, and then using conditional equations to find the numbers, as in Figure (12) and table (2).

Figure 12: It describes the LP.

Table 2: It Describes Feature Extraction

Result		د	5	6	6	4	1
Size	height	40	34	34	34	34	34
	width	35	25	25	25	25	25
region 1	Mean1	0	23	91	93	9	81
	SDiv1	0	42	116	117	17	110
region 2	Mean2	147	201	203	201	112	25
	SDiv2	123	82	79	82	124	45
region 3	Mean3	61	84	21	16	0	0
	SDiv3	92	112	38	30	0	0
region 4	Mean4	0	96	0	7	178	138
	SDiv4	0	119	0	13	105	125
region 5	Mean5	1	21	70	103	126	110
	SDiv5	2	38	101	122	126	124
region 6	Mean6	135	156	74	65	2	0
	SDiv6	125	119	105	96	4	0
region 7	Mean7	155	189	0	0	28	67
	SDiv7	120	95	0	0	49	98
region 8	Mean8	162	206	37	39	189	161
	SDiv8	116	76	63	66	95	116
region 9	Mean9	203	171	171	145	7	0
	SDiv9	80	110	110	123	13	0

Where, SDiv is Standard Deviation.

- If region1(Mean1, SDiv1) <10 and region4(Mean4, SDiv4) <10 and region5(Mean5, SDiv5) <10 then Result = " د "

- If region1(Mean1, SDiv1) <45 and region2(Mean2) >165 and region5(Mean5, SDiv5) <40 then Result = " 5 "
- If region4(Mean4, SDiv4) <20 and region7(Mean7, SDiv7) <10 and region8(Mean8) <45 then Result = " 6 "
- If region1(Mean1, SDiv1) <20 and region3(Mean3, SDiv3) <10 and region6(Mean6, SDiv6) <10 and region9(Mean9, SDiv9) <15 then Result = " 4 "
- If region1(Mean1, SDiv1) >50 and region3(Mean3, SDiv3) <10 and region6(Mean6, SDiv6) <10 and region9(Mean9, SDiv9) <10 then Result = " 1 "

CONCLUSIONS

- A conservative approachwas used for fast execution and common use, in addition to image smoothing.
- Operation morphology assisted in the process of identifying the vehicle registration plate, as well as removing some distortions by using the opening and closing morphology.
- There are many algorithms that have been used to determine the edges of the image, and the quick execution algorithm is Sobel operator, selected to achieve minimum time consumption.
- The use of some characteristics is easy from the process of classifying and distinguishing numbers and letters; especially Arabic, and the characteristics used are size, zone, mean and standard deviation.

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